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2. This guarantee does not cover:

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   ii) Home service or transport costs to the Dealer.

   iii) Damage to this product resulting from a) abuse or misuse by the customer including failure to follow Greenwich Instruments instructions in the user manual or b) the installation or use of the product in a manner inconsistent with the technical or safety standards in force at the time.


UK

Greenwich Instruments Ltd
The Crescent,
Main Road,
Sidcup,
Kent, DA14 6NW.
Tele: 020 8302 4931
Fax: 020 8302 4933

USA

Greenwich Instruments (USA)
Huntersville, P.O. Box 696,
NC, 28070.
Tele: (704) 875 8490
Fax: (704) 875 2801
1 800 476 4070

Web Site: www.greenwichinst.com


GREENWICH INSTRUMENTS LTD


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# *GSM5*

## *INTELLIGENT RS232C TO 4 PHASE STEPPER MOTOR DRIVER CARD*

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**Please read this manual fully before attempting to connect the GSM5 to the stepper motor.**

**Please read WARNINGS AND SAFETY INFORMATION on page**



## GENERAL NOTES

1 The stepper motor chosen for use with the GSM5 must be fully compatible with Bipolar drivers.

2 Motor torque is motor current and motor speed related. Torque is proportional to current and inversely proportional to speed.

3 The effective motor impedance is proportional to the load and the speed of the motor.

4 The GSM5 will supply sufficient current for motors specified at 5 Amp / phase. Motors with higher current requirements can be driven but they will not run at full power.

5 Ramps are used to provide increased starting torque and to overcome motor resonance.

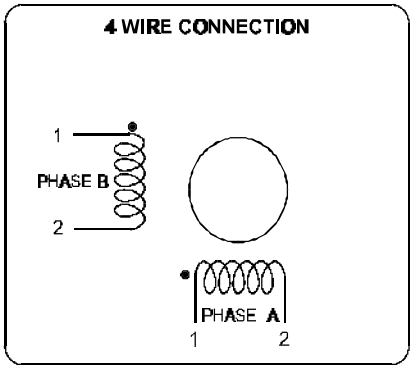
6 Current boost is dependent upon the setting of Pots 2 & 3 and is available for the length of the ramp only.

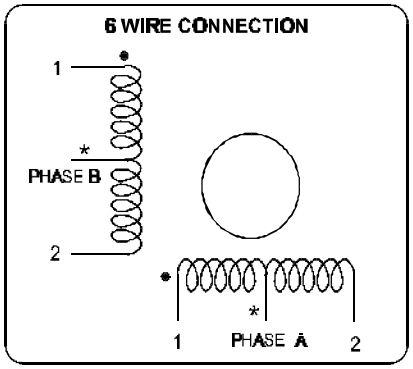
7 When adjusting Pots 2 & 3 it is recommended that the initial winding current is set at less than the value recommended for the motor and that the motor is driven at this current whilst the motor temperature is monitored. Avoid running the motor at high temperatures. (See motor manufacturers specification).

8 Stepper motor drivers generate large amounts of RFI and should be enclosed in an adequately screened enclosure, having good ventilation.

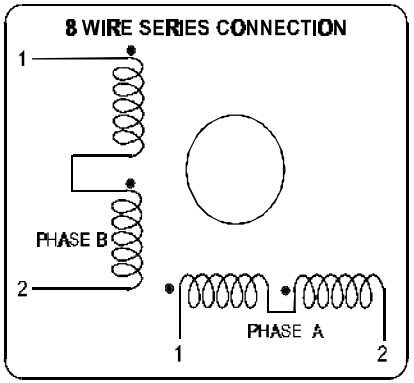
9 The GSM5 gets hot and generates high discharge voltage. Take all reasonable precautions when using.

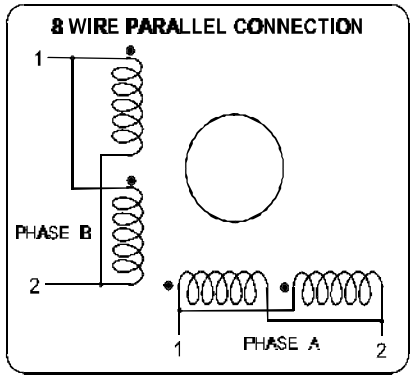
## STEPPER MOTOR CONNECTIONS




* CENTRE WIRES NOT CONNECTED




### NOTES

1. The GSM5 is not suitable for 5 wire motors.
2. Reversing the wires of any one phase will reverse the direction the motor rotates in response to commands.
3. 8 wire parallel connections give higher rotational speed.
4. 8 wire series connections provide higher motor torque.
5. Always refer to motor manufacturers data



## PRODUCT OVERVIEW

The GSM5, together with the optional PSU5 power supply, provides a comprehensive facility for controlling 4 or 8 wire Bipolar driven stepper motors. Up to 4 GSM5 cards can be daisy-chained to control up to 4 motors.

Simple software commands can be sent from a PC via the RS232 serial port to the GSM5 to control motor direction, number of steps, start and stop ramp length and slope, motor current. All commands carry address information.

On board settings include card address (0, 1, 2, 3) motor current (set to

## SPECIFICATION

**This equipment is designed to operate in half step mode only.**

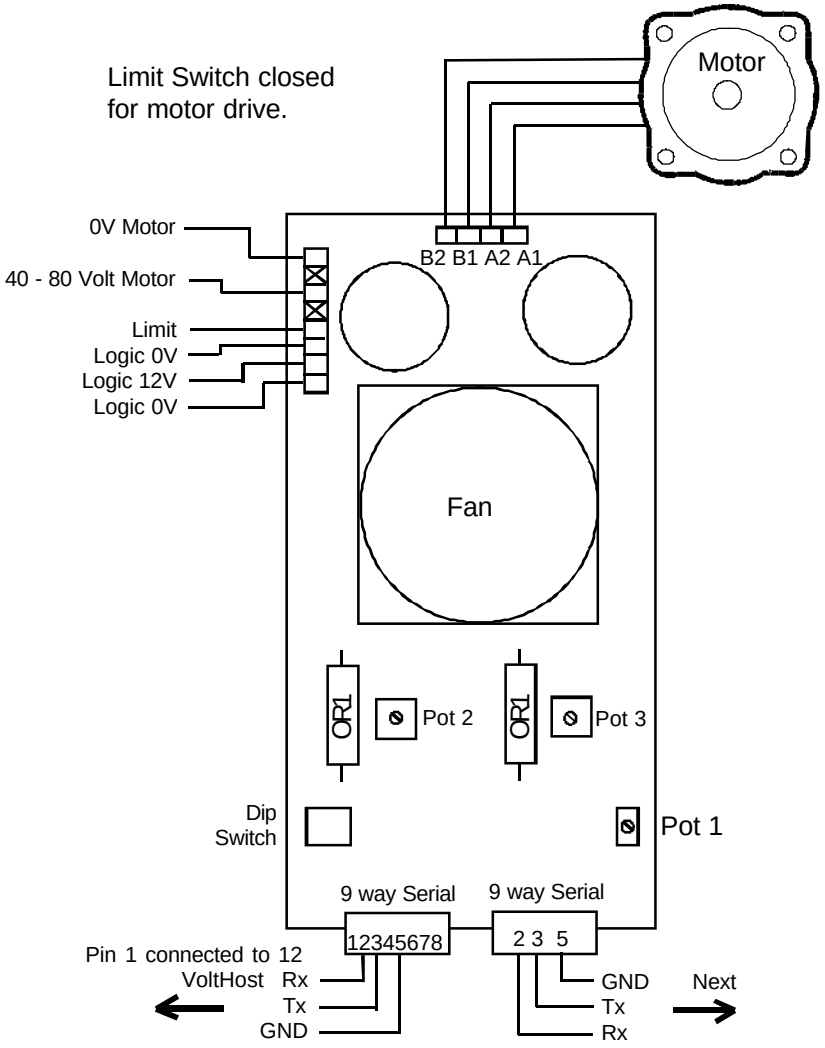
**MOTOR DRIVE:** 4 or 8 wire bipolar current switching, up to 5 ampere / phase Voltage 40 to 80 Volts DC (maximum).

**INTERFACE:** RS232C 9600 Baud, DTE via 9 pin “D” connector, Tx, Rx & GND active (Null modem) daisy-chained from card to card.

**ADDRESS:** On board card address selection 0, 1, 2, 3. Software commands include card address.

**MOTOR CONTROL:** Current, speed, direction, ½ current, boost, number of half steps (0-99999), ramp (length and slope), limit.

## BOARD LAYOUT






## UNDERSTANDING SOFTWARE (Cont.)

**NOTES**

1. If limit switches are used and motor drive options E or F are specified then the ramp parameters are disabled except that, where a ramp has been programmed, the motor speed will start at, and remain at, the motor start datum speed appropriate to the ramp
2. specified.

   Ramp Parameter. Ramp length ÷ Ramp rate (slope) is limited to a ratio of 200 : 1

   If Ramp length ÷ Ramp rate > 200 then the motor will be driven at the motor start datum speed until the ratio is equal to or less than 200 and then the ramp up will apply.

   Therefore if a ramp length of 500 half steps is chosen with a rate of 2 the ratio will be 250 and the motor will run for 100 half steps at datum speed until the ratio is 200 whereupon the motor speed

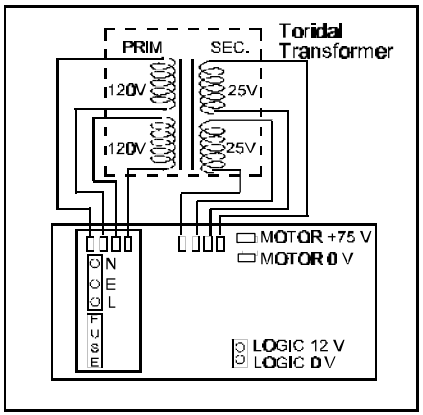
## PSU5 - POWER SUPPLY CARD
## (For use with the GSM5)

Two transformer isolated DC outputs are provided, one for logic and a second for motor drive.

| | |
|---|---|
| INPUT | 240 Volt AC |
| OUTPUT | 250 mA., @ 12 Volt DC (Logic and Fan) |
| | 3.2 Amp., @ 70 Volt DC (Motor) |

**NOTES**

For pinout / connections see block diagram. Although the motor supply is only rated at 3.2 Amp., this should be sufficient for most 5 Amp. / phase stepper motors. Short circuit protection, and mains voltage shielding is left to the customer to implement.

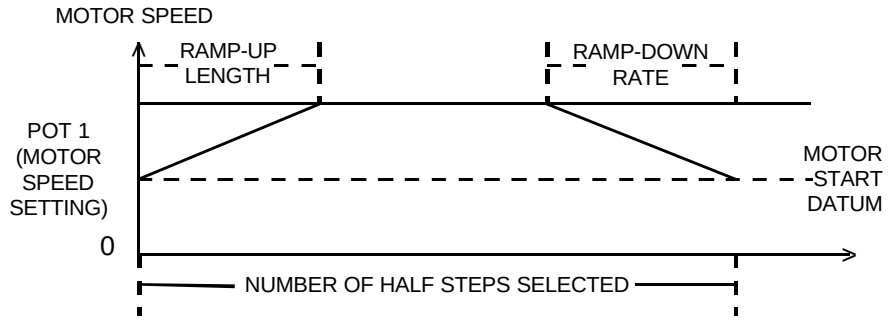



**DIMENSIONS**

LENGTH.....160mm
WIDTH.....100mm
HEIGHT.....55mm

## UNDERSTANDING SOFTWARE (Cont.)

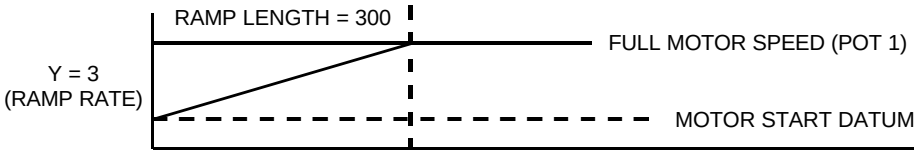
**RAMPS**




$$\text{MOTOR START DATUM SPEED} = \frac{\text{MOTOR MAXIMUM SPEED X 48}}{48 + \left(\frac{\text{RAMP LENGTH}}{\text{RAMP RATE *}}\right)}$$

* If the slope of 0 is specified then Ramp Rate = 256 otherwise the rate is as programmed by the F command.

EXAMPLE




$$\text{MOTOR START DATUM SPEED} = \frac{\text{MOTOR MAX. SPEED (POT 1 SETTING) X 48}}{48 + \left(\frac{\text{RAMP LENGTH}}{\text{RAMP RATE}}\right)}$$

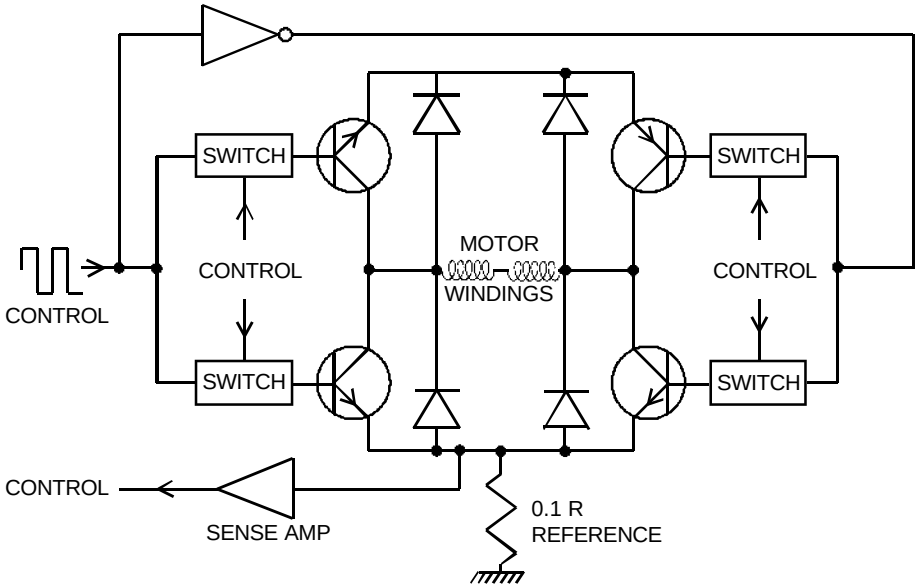
For the example above, if motor speed set at 400 half steps / second,

$$\text{MOTOR START DATUM SPEED} = \frac{400 \text{ X } 48}{48 + \frac{300}{3}} = \frac{19200}{148} = 130 \text{ Half Steps / Sec.}$$

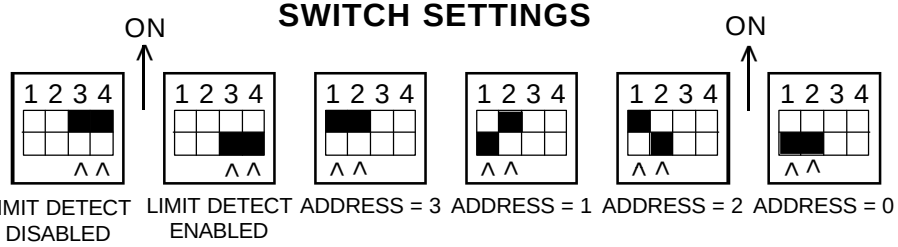


## MOTOR DRIVE SCHEMATIC

**( One Phase )**




## SWITCH SETTINGS




## DIMENSIONS

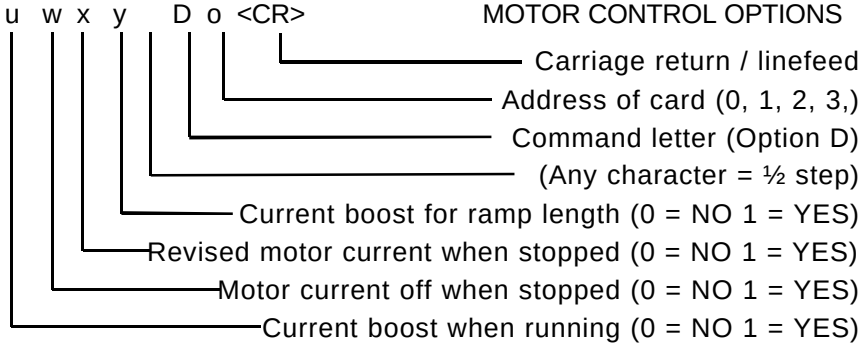
Length = 210mm  Width = 100mm  height = 75mm

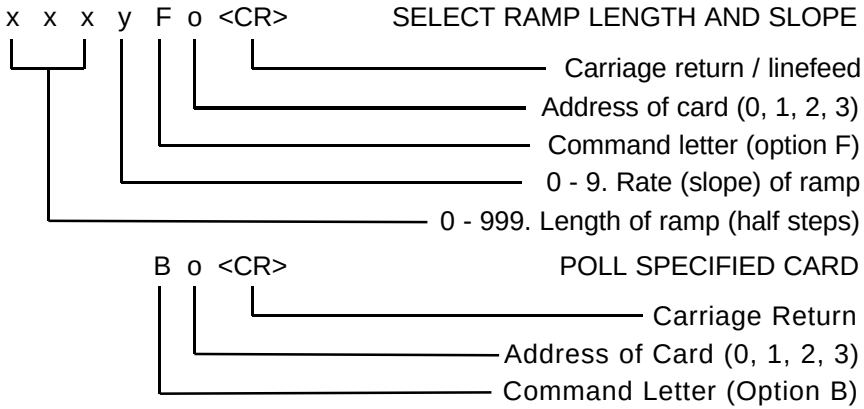
## SOFTWARE COMMANDS

All software commands, sent via the RS232 interface , are of the format - **number, command letter, address (0, 1, 2, 3, )** followed by carriage return **<CR>** or **linefeed**. The card will echo back via the RS232 the command letter and the card address.

**SOFTWARE OPTION COMMANDS**

The following commands select card parameter options associated with motor current, ½ step, ramp length and slope. (If not specified default settings would apply - See page 7)


u w x y D o <CR>
MOTOR CONTROL OPTIONS
Carriage return / linefeed
Address of card (0, 1, 2, 3,)
Command letter (Option D)
(Any character = ½ step)
Current boost for ramp length (0 = NO 1 = YES)
Revised motor current when stopped (0 = NO 1 = YES)
Motor current off when stopped (0 = NO 1 = YES)
Current boost when running (0 = NO 1 = YES)


x x x y F o <CR>
SELECT RAMP LENGTH AND SLOPE
Carriage return / linefeed
Address of card (0, 1, 2, 3)
Command letter (option F)
0 - 9. Rate (slope) of ramp
0 - 999. Length of ramp (half steps)




This command polls the card specified at address entered and returns an ID message plus limit switch status. e.g. B GSM5 999 JUN 95 L/F C/R or B GSM5 999 JUN 95 Limit Open L/F C/R



## UNDERSTANDING THE SOFTWARE COMMANDS

There are two motor drive option commands, options D and F.

Option D has 5 sub-options

Sub-option “u” selects 100% motor current when running. (If not selected motor runs at 66%).

Sub-option “w” selects motor current Off when motor stopped.

Sub-option “x” selects ½ motor current when motor stopped.

Note: If both options “w” and “x” are selected then option “w” will override option “x”.

Sub-option “y” selects current boost for ramp length.

All sub-options are selected / deselected by 1 or 0. 1 = select 0 =

Option F has two sub-options

Sub-option “xxx” can be specified between 001 and 999 to set the length of the ramp, (number of ½ steps)

Sub option “y” can be specified between 1 and 9 to set the slope of the ramp.

(See page 11 for further explanation of ramp settings).

There are four movement command options A, C, E, G.

A and E give anticlockwise movement.

C and G give clockwise movement.

Command option A specifies anticlockwise movement for 1 to 99999 half steps

Command option C specifies clockwise movement for 1 to 99999 half steps

Command options E and G specifies anticlockwise or clockwise movement for 1 to 99999 half steps or until the limit switch opens, which ever event happens first. (No Ramp, stays at start speed).

## USING CONTROL PROGRAM (Cont.)

To run the software in the normal control mode, enter the following at the DOS prompt : C:\> GSM5TERM

When the software first runs, it sends ID requests to each of the four possible GSM5 units which could be connected. If any respond, this is noted and a status message is printed showing which GSM5 addresses are active. The last GSM5 which responded, becomes the default one. To select a different GSM5, use the number keys 0,1,2 & 3. If the requested GSM5 is not active, an error message will be displayed.

### USING THE SOFTWARE

Each of the GSM5 commands has been assigned to a function key as follows:

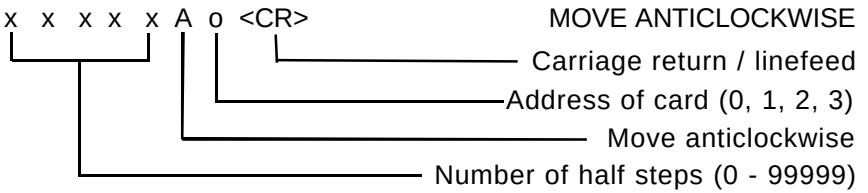
| Command | Key | Purpose |
|---|---|---|
| A | F1 | Move Anticlockwise |
| C | F2 | Move Clockwise |
| E | F3 | Move Anticlockwise or until limit switch operates |
| G | F4 | Move Clockwise or until limit switch operates |
| D | F5 | Set-up Motor control options |
| F | F6 | Set-up Ramp length and slope |

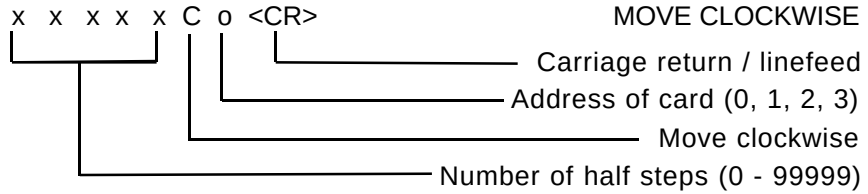
Each of the above commands will ask for any required parameters and will wait until the command has finished and the GSM5 is ready for another command before continuing.

An additional mode is included in the software in which the motor can be driven using the left and right cursor keys and displays the total offset from the start position. Each press of the left or right cursor keys moves the motor 10000 half steps in the chosen direction (left cursor = clockwise, right cursor = anticlockwise). The number of half steps can be changed using the PgUp and PgDn keys. The total number of half steps moved is displayed with the direction. It also allows the motor to be automatically moved back to the “zero” reference point. This is a simple way of checking the repeatability of the mechanical system attached to the motor.



### SELECT MOTOR MOVEMENT COMMANDS


x x x x x A o <CR>
MOVE ANTICLOCKWISE
Carriage return / linefeed
Address of card (0, 1, 2, 3)
Move anticlockwise
Number of half steps (0 - 99999)



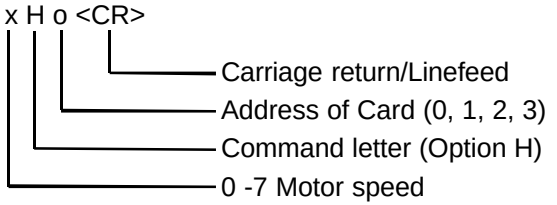

x x x x x E 0 <CR> MOVE ANTICLOCKWISE
SPECIFIC NUMBER OF HALF STEPS (0-99999) OR UNTIL LIMIT SWITCH OPERATES. No Ramp, stays at start speed. (See Ramp Parameters page 11)

x x x x x G o <CR> MOVE CLOCKWISE
SPECIFIC NUMBER OF HALF STEPS (0-99999) OR UNTIL LIMIT SWITCH OPERATES. No Ramp, stays at start speed. (See Ramp Parameters page 11).

### PROGRAMMABLE MOTOR SPEED CONTROL

Programming command H has been assigned to provide seven programmable motor speeds.

The format of the command is :-




Motor speed settings are:-

0 = Speed as set by Pot 1
1 = 4,800 half steps per second
2 = 2,400 ditto
3 = 1,200 ditto
4 = 600 ditto
5 = 300 ditto
6 = 150 ditto
7 = 75 ditto

The default/power on setting is 0; speed setting defined by POT 1 adjustment.

**GSM5TERM>EXE Software Control of Motor Speed**

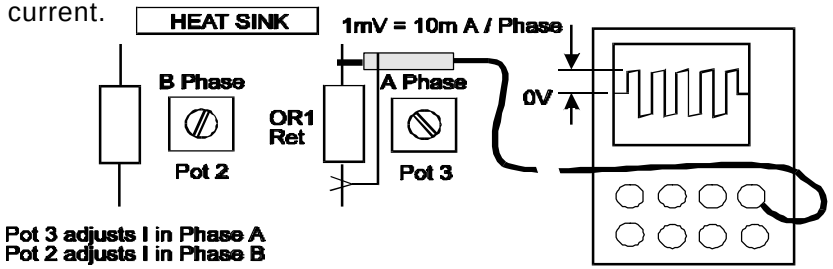
When the program GSM5TERM is run, or GSM5TERM TESTMODE, the motor speed selection column is shown to the right of the screen. The up/down ( ^, ) cursor keys are used to select the required motor speed. The => point to the selected speed. The speed selected will apply for all other commands until another speed is selected.

The "Variable" option is the speed selected by the pot 1 setting.

## GSM5 - ON BOARD SETTINGS

**POT 1** Pot 1 adjusts the speed of the motor in ½ steps / second. This pot should only be adjusted as required during the setting up stage of the process to give the required motor speed.

**POT 2 & POT3** Pot 2 & 3 are adjusted to provide the required winding current for the motor. It is advisable to start with the pot at minimum (fully clockwise) and increase slowly until motor current is sufficient to drive the motor. To adjust the current connect an oscilloscope across Ref. (0.1R) resister. Adjust POT 2 or 3 for required reading of wave form where 0.1mV = 10 mA winding current.




For example if the motor winding recommended current is 4.5 Ampere then the pot 2 should be adjusted to read 450mV+ VE on oscilloscope.
A limit switch may be connected to the GSM5.

**SERIAL PORT SETUP (COM 1)**

9600 Baud
8 Bits
No Parity
1 Stop Bit



**DEFAULT SETTINGS**

On power up the GSM5 sets to the following default settings.

100% motor current option OFF.
Half motor current when stopped.
Current boost for ramp OFF.
No Ramp.
Half step mode

## WARNINGS AND SAFETY INFORMATION

1. Stepper motors and some components on the GSM5 get very **HOT**!
2. Ensure motors are not over driven! Refer to motor specification.
3. Ensure the GSM5 and PSU5 are well ventilated.
4. **DO NOT** disable the GSM5 fan.
5. **WARNING** High voltages are generated on the GSM5 circuit board. Stepper motors generate high "Back EMF" voltages. Allow time for the magnetic fields to decay and caps to discharge after disconnecting the power before disconnecting the motor.
6. DO NOT connect or disconnect the motor with power supplied to the GSM5
7. **The MAXIMUM** motor drive voltage is 80 V.
8 Ensure the mains input is adequately fused.
9. The GSM5 and stepper motors generate RF frequencies, appropriate screening is recommended.

## USING CONTROL PROGRAM

**INTRODUCTION**

The GSM5TERM.EXE program is a simple self contained RS232 controller which allows new users of the GSM5 stepper motor controller to get a system up and running very quickly. It offers all the features of the GSM5 to the user by assigning the various commands to function keys and asking for the required parameters where necessary. The software can be used in two modes. Normal mode allows the control of up to 4 GSM5 units, while test mode allows the software to be used without the need for a GSM5 unit to be present. To run the software in test mode, enter the following at the DOS prompt: **C:\> GSM5TERM TESTMODE .** Use this mode to become familiar with the software.